

Renewable Energy

2010 Zoning Ordinance Amendments

Planning Commission Work Session

October 20, 2009



What is Renewable Energy?

- Energy created from “endless” sources or that can be rapidly replaced or regenerated by natural processes
- Energy is captured from existing flows of energy, on-going natural processes, biological processes and geothermal heat
- Examples include: **solar**, water, **wind**, (hydro-power), fuel from plants, geothermal, anaerobic digestion, rain and tides



Evolution of Wind Power



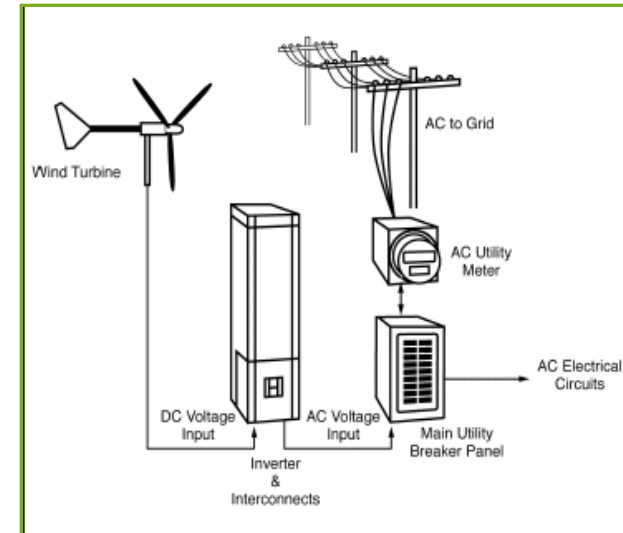
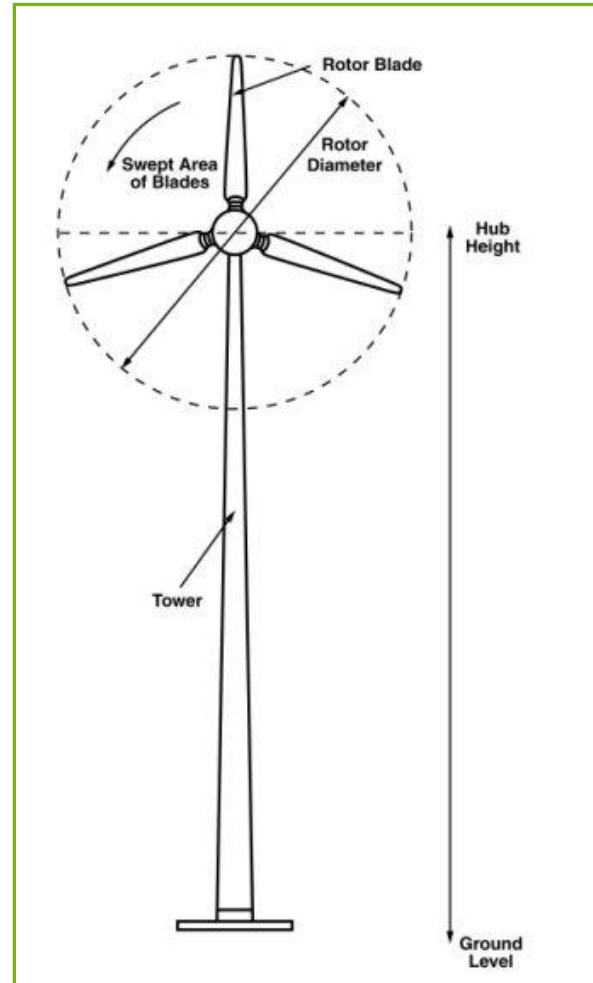
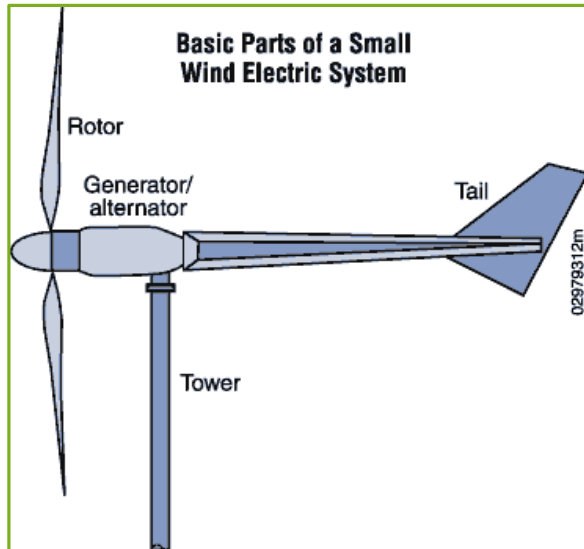
Source: American Wind Energy Association (AWEA)

Types of Wind Energy Systems

- Small-Wind System
 - Building Integrated/ Micro Wind System
- Large-Wind
- Utility Scale Systems
- Wind Monitoring or Meteorological Towers (MET Towers)
- Hybrid Systems

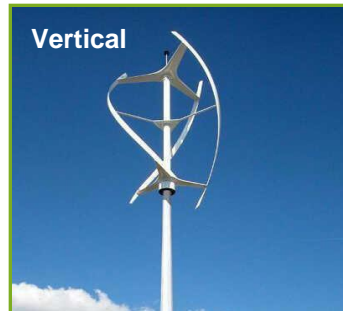


Components of Wind Energy Systems

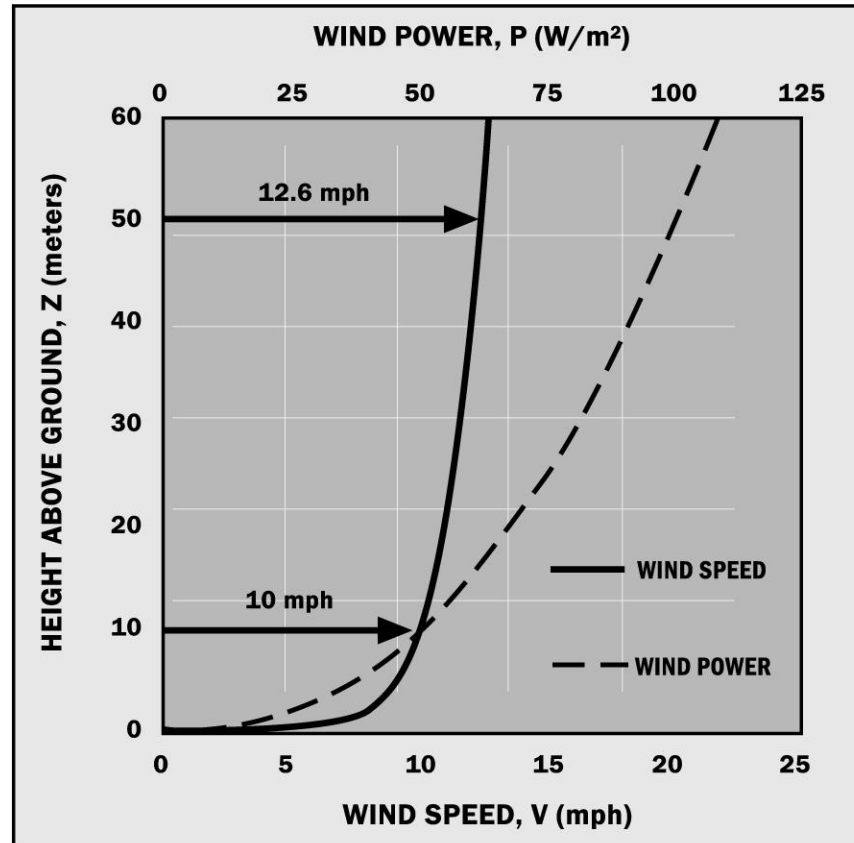


Types of Towers

- Two Types: **Guyed** and **Freestanding**
- **Guyed** Towers- lightweight, supported by permanent guy cables, fabricated using either a lattice structure or a pipe
- **Freestanding** Towers- taper from a larger base at ground level to a point where the wind turbine is mounted
 - **Horizontal** & **Vertical** Axis



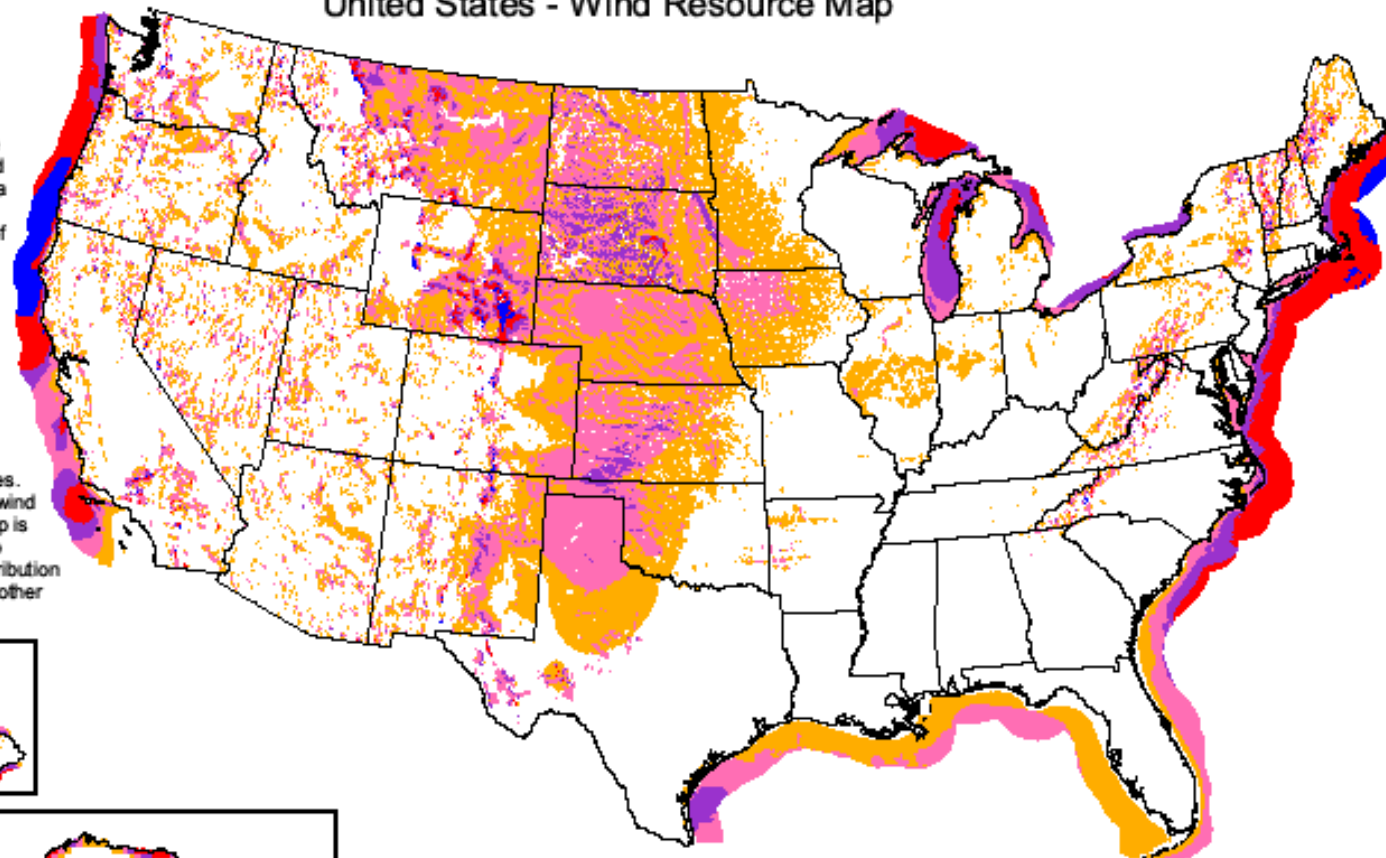
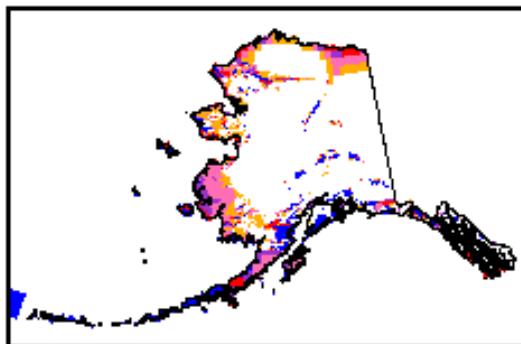
Typical Wind Shear Profile



Typical Wind Shear Profile — Speed and power available in the wind increases with increasing elevation. The relationship is commonly referred to as the one seventh power law ($a=1/7$).

United States - Wind Resource Map

This map shows the annual average wind power estimates at a height of 50 meters. It is a combination of high resolution and low resolution datasets produced by NREL and other organizations. The data was screened to eliminate areas unlikely to be developed onshore due to land use or environmental issues. In many states, the wind resource on this map is visually enhanced to better show the distribution on ridge crests and other features.



Wind Power Classification

Wind Power Class	Resource Potential	Wind Power Density at 50 m W/m^2	Wind Speed ^a at 50 m m/s	Wind Speed ^a at 50 m mph
3	Fair	300 - 400	6.4 - 7.0	14.3 - 15.7
4	Good	400 - 500	7.0 - 7.5	15.7 - 16.8
5	Excellent	500 - 600	7.5 - 8.0	16.8 - 17.9
6	Outstanding	600 - 800	8.0 - 8.8	17.9 - 19.7
7	Superb	800 - 1600	8.8 - 11.1	19.7 - 24.8

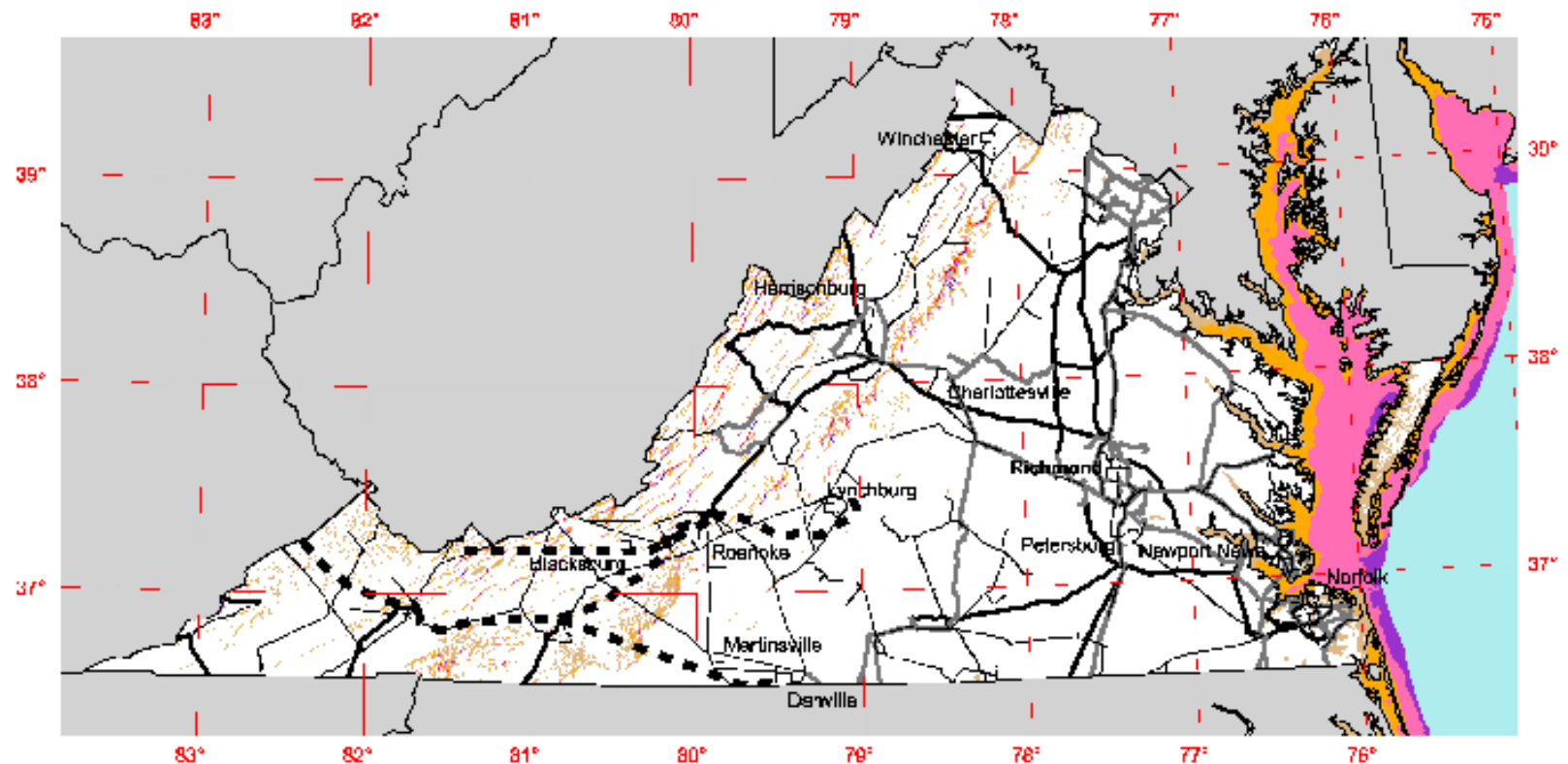
^a Wind speeds are based on a Weibull k value of 2.0



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Virginia - 50 m Wind Resource Map



Wind Power Classification

Wind Power Class	Resource Potential	Wind Power Density at 50 m W/m^2	Wind Speed ^a at 50 m m/s	Wind Speed ^a at 50 m mph
1	Poor	0 - 200	0.0 - 3.8	0.0 - 12.5
2	Marginal	200 - 300	3.8 - 6.4	12.5 - 14.4
3	Fair	300 - 400	6.4 - 7.0	14.3 - 15.7
4	Good	400 - 500	7.0 - 7.5	15.7 - 16.8
5	Excellent	500 - 600	7.6 - 8.0	16.8 - 17.9
6	Outstanding	600 - 800	8.0 - 8.8	17.9 - 19.7
7	Superb	> 800	> 8.8	> 19.7

^a Wind speeds are based on a Weibull k value of 2.0

Transmission Line^a Voltage (kV)

- 115 - 138
- 161
- 230
- 500
- 765

^a Source: POWERmap, ©2002
PacifiCorp, a Division of the McGraw-Hill Companies

0 50 100 Kilometers
0 25 50 Miles

The annual wind power estimates for this map were produced by TrueWind Solutions using their Mesomap system and historical weather data. It has been validated with available surface data by NREL and wind energy meteorological consultants.

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DOI: 10.1037/0893-3200.13.4.595



- ☐
- Locality of Interest



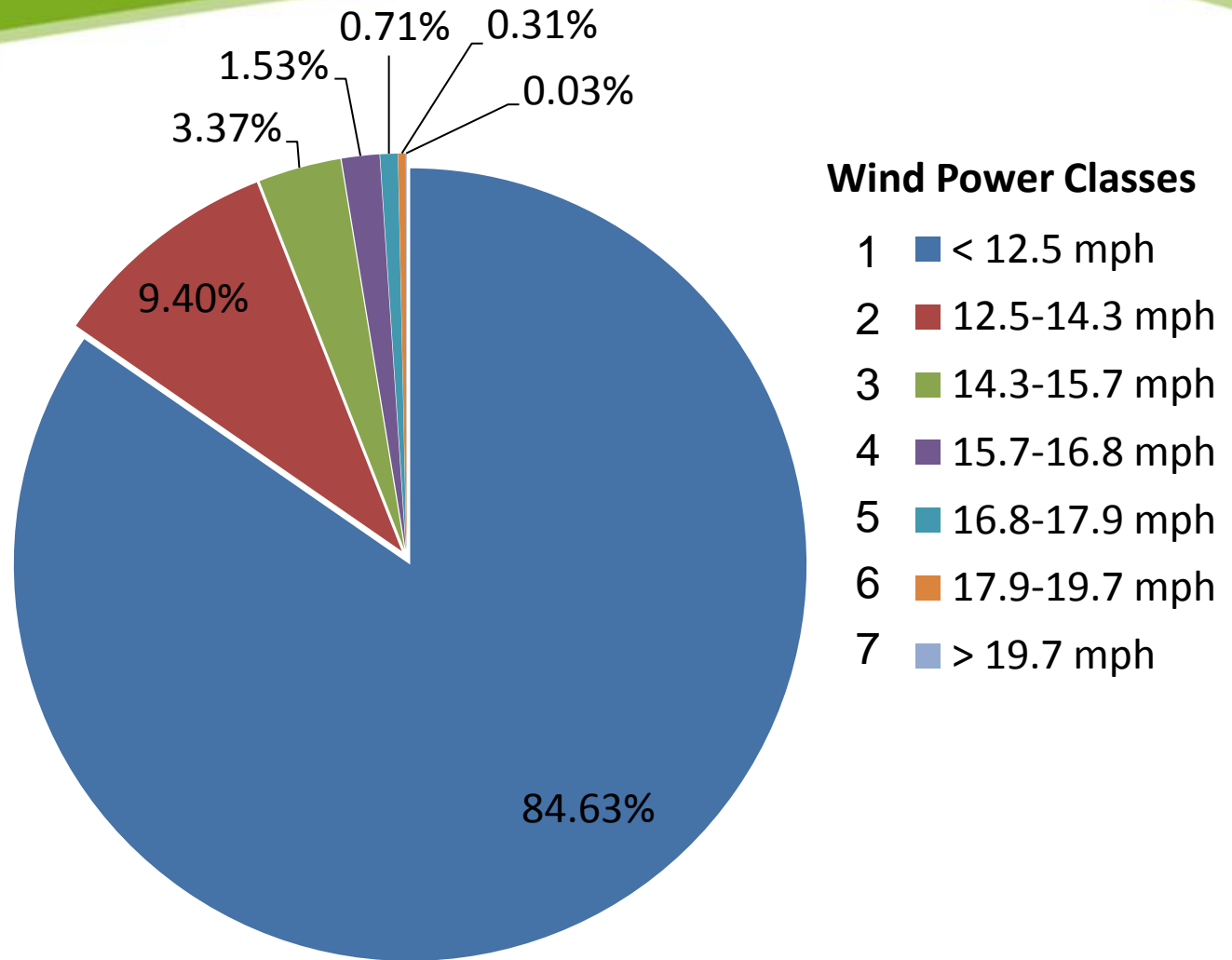
-  Town
 City
 County Boundary
 Census Designated Place

— Interstate
 --- US and State Roads

- Government Land**
 Federal Land
 State Land

Major Bodies of Water

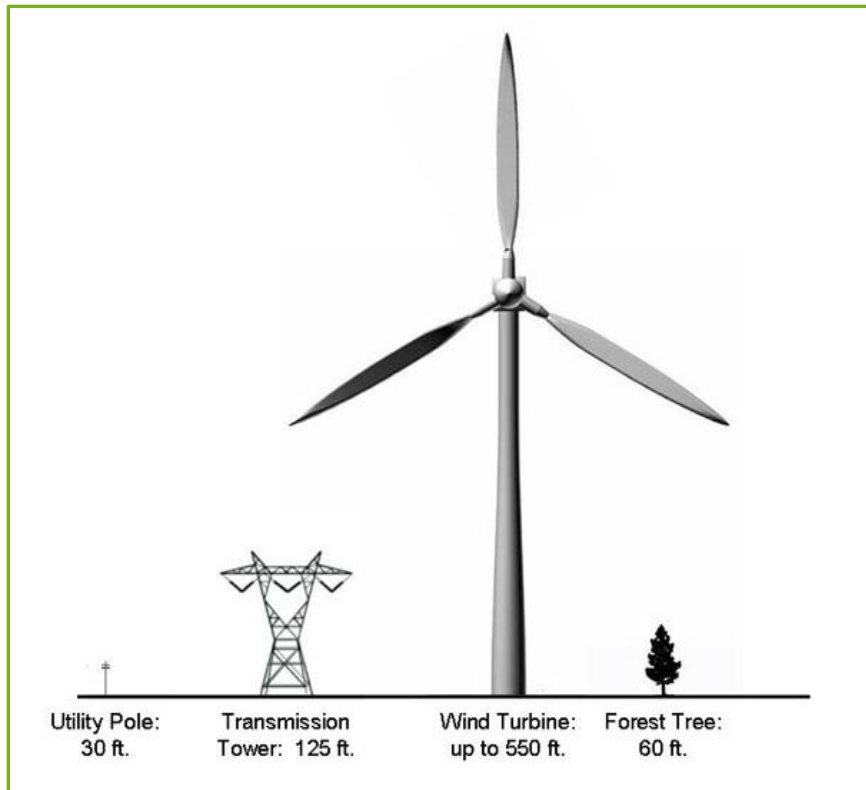
Wind Resource Analysis of Roanoke County



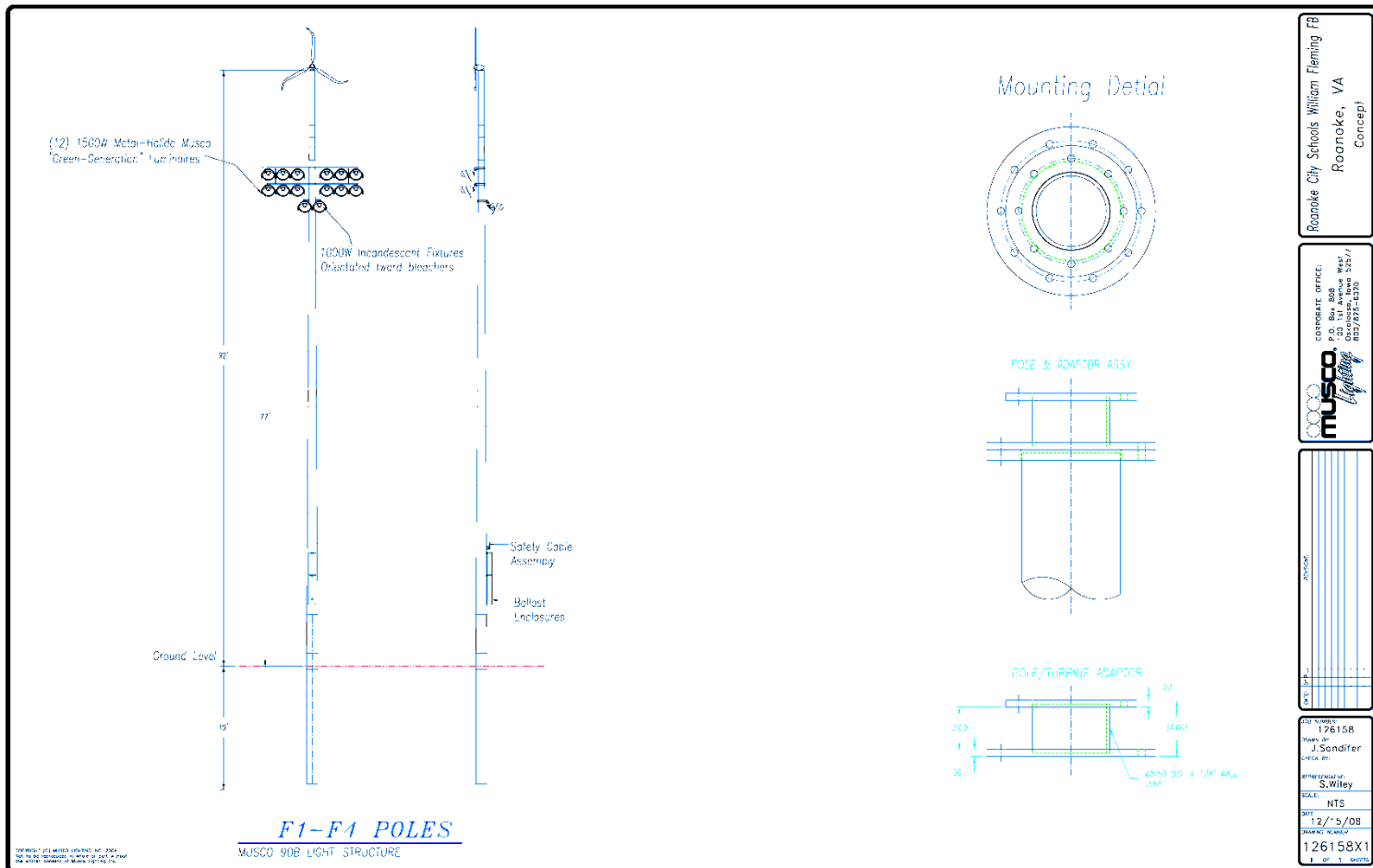
Zoning and Wind Energy Systems

Issues

- **Use Type**
 - Accessory
 - Principal
 - Minor/Major Utility
- **Permitted Zoning Districts**
- **Site Development Regulations**
 - Setbacks
 - Height
 - Aesthetics
- **Safety**
 - Permits
 - Industry Standards
 - Abandonment/Decommissioning

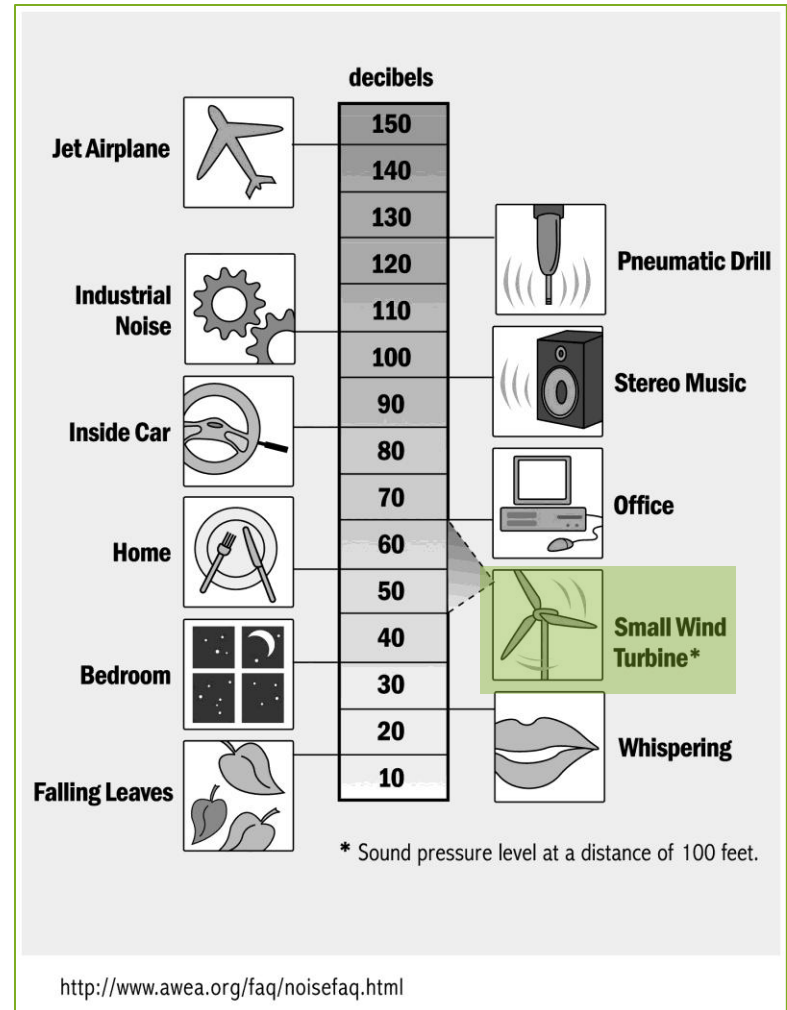


Wind Energy in the Roanoke Valley



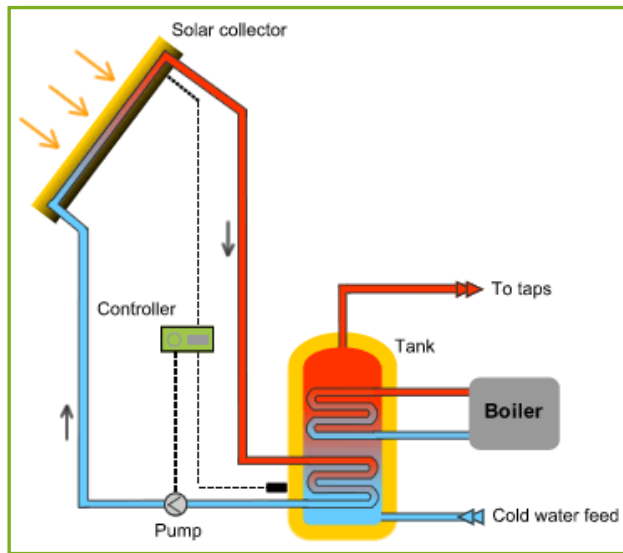
Wind Energy – Public Concerns

- Property Values
- Viewsheds
- Bats and Birds
- Safety – blade failure, ice, etc.
- Noise
- Construction
- Decommissioning/
Abandonment
- Electronic Interference
- Shadow Flicker
- Costs/Return of Investments

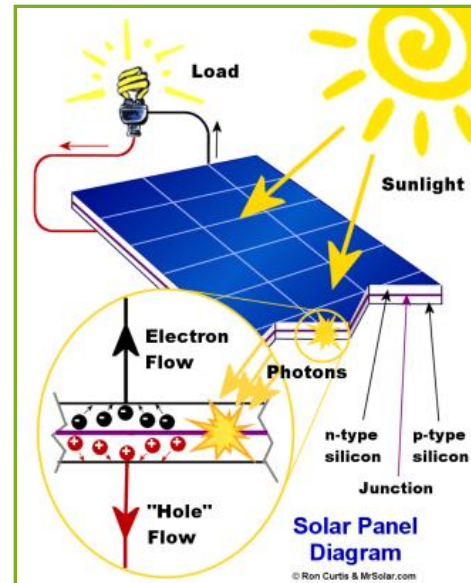


Types of Solar Energy Systems

Active Solar Technology



Photovoltaics



Energy from the sun is converted into thermal or electrical energy

Solar Energy System Mounts



Roof Mount



Building Integrated Mount

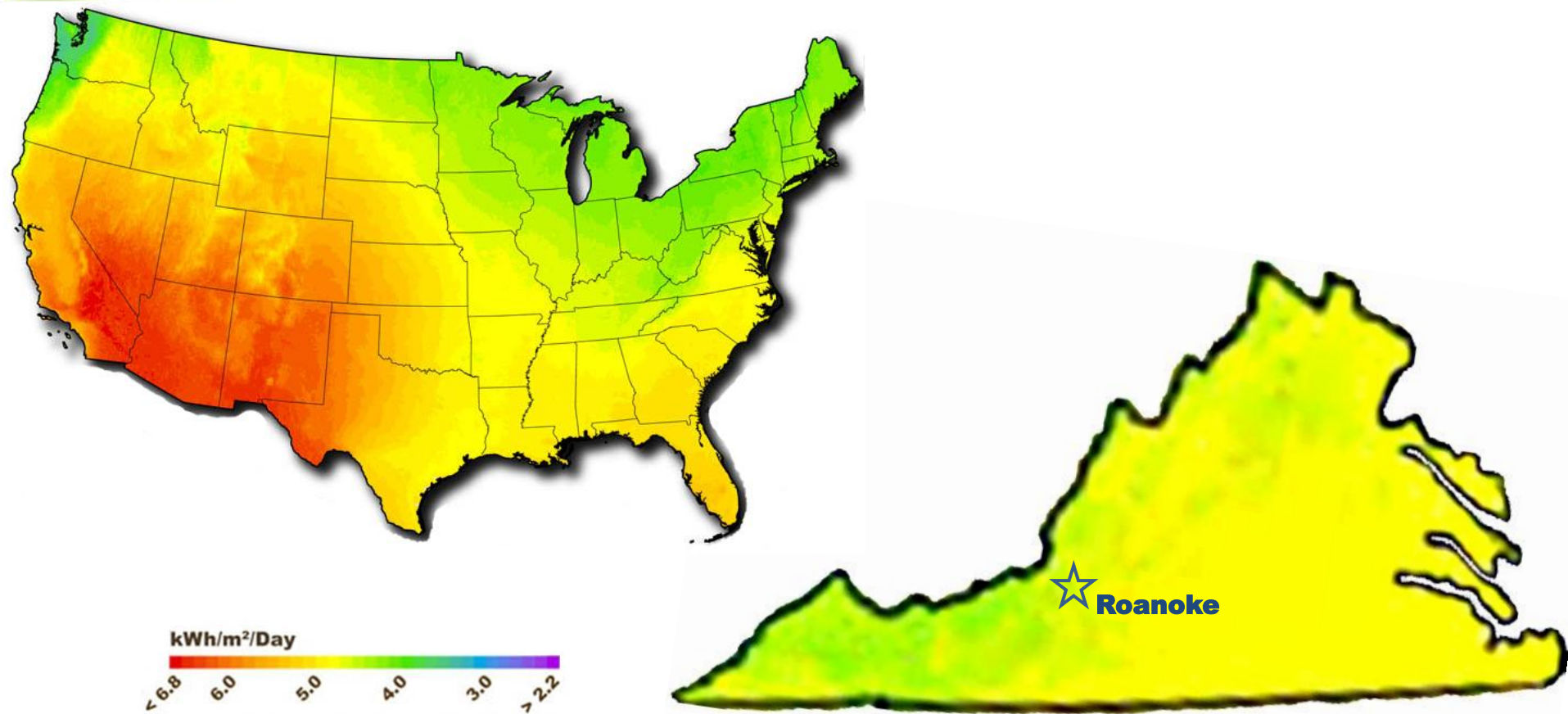


Pole Mount



Ground Mount

Solar Resource Maps



Zoning and Solar Energy Systems

Issues

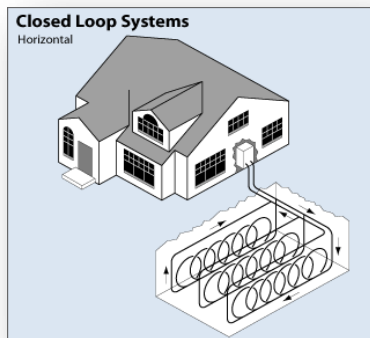
- **Use Type**
 - Accessory
 - Principal
 - Minor Utility
- **Site Development Regulations**
 - Setback
 - Height
 - Lot Coverage
- **Safety**
 - Permits
 - Industry Standards



Other Renewable Energies Considered

Geothermal

- Energy derived from the heat in the interior of the Earth
- Types: Direct Use, Electricity Generation and ***Space Heating***



Bioenergy

- Renewable energy made from any organic material from plants or animals
- Generates electricity and power; produces liquid transportation fuels



Questions, Comments or Concerns?

